EXHIBIT 4, ATTACHMENT B:

David Rupp, Cerulean Warbler Survey Results in the Houston South Project Area (2020)

RESULTS OF CERULEAN WARBLER SURVEY IN HOUSTON SOUTH MANAGEMENT AREA OF HOOSIER NATIONAL FOREST, 2020.

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Introduction

In advance of proposed forest management activities in the Houston South Vegetation Management and Restoration Project area of Hoosier National Forest (HNF), the Indiana Forest Alliance (IFA) asked me to survey the project area for the presence of the Cerulean Warbler (*Setophaga cerulea*), a Neotropical migrant songbird that nests in large tracts of mature forests in Indiana and other parts of eastern North America. The Cerulean Warbler is listed as State Endangered on the Indiana list of Species of Greatest Conservation Need (DNR, June 2020). The Breeding Bird Survey has indicated an average of a 3.2% annual population decline of this species from 1966-2017 in Indiana, and an average decline of 2.7% per year across its entire range during the same period (https://www.mbr-pwrc.usgs.gov/) (Pardieck et al., 2020).

During nesting season, Cerulean Warblers occupy deciduous forests with diverse canopy structure, often featuring large trees and canopy gaps (USFWS, 2006). They have been documented inhabiting a variety of forest types: upland forest, wet bottomland forest, and mesic slopes. In addition, Ceruleans have been shown to form clusters within the breeding habitat (Roth & Islam, 2007), often grouped in high densities in one area with none to be found in similar adjacent areas.

The Indiana Forest Alliance was concerned about a lack of recent data pertaining to the presence and location of the imperiled Cerulean Warbler in the Hoosier National Forest. They hired me to survey the Houston South Project area because of my previous experience searching for Cerulean Warbler nests in Yellowwood and Morgan-Monroe State Forests for both the Hardwood Ecosystem Experiment and the IFA. The goal was to obtain a pre-management baseline understanding of the abundance and distribution of the Cerulean Warbler in the Houston South area.

Methods

Starting on April 20, 2020, I hiked the trails, bushwhacked off-trail, and drove the roads of the Houston South area several times per week. While I did not follow any grid system or scientific method to the census, I did try to walk each of the trails in the area at least once. I'm sure that I spent more time off trail than on, especially in areas where Cerulean Warblers were present. During my hikes, I kept an eBird list of all bird species that I heard or saw and tracked the distance I covered.

From April 20 through May 13, I spent 11 days in the field searching for Cerulean Warblers in Houston South. I surveyed for birds for 46.5 hours and covered approximately 57.5 miles. (Both numbers were tracked using the eBird app.) I spent an additional 12 hours specifically tracking Ceruleans and documenting their locations.

Upon hearing a male Cerulean vocalizing, I would locate the tree it was singing from and try to visually spot it as well. I would then record the GPS coordinates of the bird's location. I would also note any Cerulean Warbler behavior beyond territorial singing—female chip notes, battles between males, nest

site searching, or whisper or shortened songs—which indicate a likelihood of a nesting attempt in the area.

Because Cerulean males often cluster their territories, I revisited some of the sites with higher Cerulean densities to get GPS coordinates of birds I may have missed and to see if individuals were maintaining their territories. I also revisited areas that I went to early in the spring to see if any Ceruleans had arrived after my first visit. After having surveyed most of the Houston South area, I spent additional time visiting locations where I had previously observed females in an attempt to find a nest or nest-building activity. I rarely kept complete bird lists on these outings as my attention was focused on the Ceruleans. On many of these occasions, volunteers were enlisted to help in the nest search and to take photographs of the birds.

From May 18 through June 2, I spent nine days totaling 42 hours in the field primarily focused on finding Cerulean Warbler nests. Over the course of these outings, 15 people (both volunteers and IFA staff) assisted for an additional 88 person-hours in the field. Nest searching involved using both visual and auditory clues to locate a female Cerulean Warbler and then attempting to track her back to her nest location. Upon finding a nest location, we made multiple visits to the nest location for monitoring purposes. All data was entered in a comprehensive spreadsheet.

Results

List of Birds Observed

Over the duration of these outings into the Houston South area of HNF, I observed exactly 100 species of birds (see Appendix 1). These species included early migrants (e.g. Yellow-bellied Sapsucker and Winter Wren on April 20) as well as late ones (e.g. Connecticut Warbler on May 20 and Black-billed Cuckoo on May 24). Also observed were 27 species of warbler, of which 17 likely breed/nest in the Houston South area and the other 10 use HNF as a stopover site during migration.

The most abundant bird species were ones considered to be forest interior specialists and forest generalists. The most abundant forest interior specialists included Red-eyed Vireo, Wood Thrush, Ovenbird, Worm-eating Warbler, and Scarlet Tanager. The most abundant forest generalists were the Red-bellied Woodpecker, Blue Jay, Carolina Chickadee, Tufted Titmouse, White-breasted Nuthatch, Blue-gray Gnatcatcher, Brown-headed Cowbird, and Northern Cardinal.

Five species of State Special Concern were observed in the Houston South area. Although I did not do any surveys at night, I did flush a pair of Eastern Whip-poor-wills on May 4 near Trail 18 and observed another one on May 6 near Starnes Branch. Broad-winged Hawks were observed on eight different days throughout the spring. Three listed species of warblers—the Worm-eating, Black-and-White, and Hooded—are relatively abundant in this section of the HNF and were observed regularly.

We were able to document reproductive behavior for several species with photographs. We found a Black-and-white Warbler female carrying food for its young on May 24 along Polk Patch Rd. (see Photo 1). We observed a Red-eyed Vireo (see Photo 2) and an Eastern Wood-Pewee (see Photo 3) putting the finishing touches on their respective nests on May 30 near where trails 18 and 20 meet. A very vocal Worm-eating Warbler led us to its nest on the side of a bank along Trail 20 where it had three young chicks on June 2 (see Photo 4). Many other times nests and nest building behavior were observed without photographic documentation for a variety of forest songbird species.

Cerulean Warbler Abundance and Location

I first observed Cerulean Warblers this spring on April 24, 2020, a bit later than expected, likely due to a cold April. From April 24 to June 1, I marked the location of 82 singing males (see Appendix 2). The first female was observed on May 1, nearly a week after the first male, which is also to be expected (Hamel, 2000). I noted 13 individual females during the study (see Photo 5), a few of which we followed quite closely.

My observations largely reinforced previous scientists' observations of clustered territories. A male Cerulean was usually located within earshot of another singing male or even several singing males. In contrast, there would be areas of the forest where I would hike one or two miles without hearing one. Over the course of the spring, it became clear that most of the clustering was along the South Fork of Salt Creek, its tributaries, and the slopes just above these lowland floodplains (see Map 1). While these slopes included white oak, the lowlands featured a diversity of trees. The most consistent traits of the Cerulean Warbler territories were lower elevation, proximity to the South Fork of Salt Creek or one of its tributaries, and a structurally diverse forest canopy.

The clustering of territories can be seen at a finer scale in Map 2, a closer view of the Fleetwood Branch near its confluence with the South Fork of Salt Creek. The clustering of the Cerulean Warbler territories gives a density of 22 territories in this square mile. When examining just the southeast corner of this square mile, the density of territories is much greater.

Evidence of Cerulean Warbler Nesting Behavior

On three occasions Cerulean Warbler females were observed building nests. Having previously observed Cerulean Warbler females and numerous male territories along Trail 21, three of us revisited the trail on May 18. With teamwork, we were able to trace one of the females back to a nest that she was in the early stages of building in the territory labeled C21c. The nest was located in a white oak on a fork in a branch approximately 35 feet directly above the trail (see Photo 7). We also located a Cerulean pair in the adjoining territory C21b but were unable to determine if they were nesting.

On May 22, five of us searched the area surrounding the Trail 18 and Trail 20 junction, a place where Cerulean Warbler clustering was particularly dense. We located multiple female Ceruleans and eventually observed nest building in an American elm in the floodplain between the two trails. However, when we revisited both this and the territory C21c nest locations later in the month, the nests were no longer present.

Near the switchbacks on Trail 18 on May 30, three of us witnessed a female building a nest approximately 45 feet up in a White Oak just upslope from the floodplain (see Photo 8). She was coming down near the ground to gather the materials, then flying straight to the nest, which was almost finished (see Photo 9). In this case, the nest was still present on our following visits, so we were able to check on it periodically to see the nesting progress. On June 19 the nest had young nestlings (see Photo 10), and on June 29 the nest was empty, so the young had presumably fledged.

Discussion

The importance of Hoosier National Forest to nesting forest songbirds cannot be overstated. High numbers of forest interior birds flourish in a large, forested landscape such as this one. I estimate that approximately 60 of the 100 species identified in Houston South are likely to nest in the area. However, bird diversity shouldn't be the ultimate measure of a large forest's importance; rather, the presence and success of species dependent on forest interior habitat is a more valuable indicator of the uniqueness of HNF in the broader landscape. Quantifying the presence of forest interior birds is much easier than measuring the reproductive success of these species, especially with limited time and resources. However, a thorough observational study like this one allows for some increased understanding of the species that inhabit this forest.

The Wood Thrush (*Hylocichla mustelina*) is listed as a "'D' Yellow Watch List Species" by the Partners in Flight conservation network due to its declining population in eastern forests. These declines have been linked to habitat loss and forest fragmentation in both its breeding and wintering grounds; breeding success has been shown to decrease in small, fragmented forests where nest predators and parasites (Brown-headed Cowbirds) are major threats (Partners in Flight, 2020). The Wood Thrush was a bird commonly encountered during these surveys and the second most abundant species on IFA point count surveys in the nearby Combs Creek 2020 Ecoblitz area (report in progress).

Another "'D' Yellow Watch List Species" is the Cerulean Warbler, the focus of this study. Although there has been a Breeding Bird Survey route through parts of the Houston South Project area for most years since 1990 that has indicated the presence of Cerulean Warblers (USGS, 2020), we did not know what levels of abundance to expect or where all we might find them. What we found surprised us. The numbers speak for themselves; Cerulean Warblers are well established in many sections of the Houston South Project area. I found them to be inhabiting a wide area that encompassed Combs and Fleetwood Branches on the northwestern side of the South Fork Salt Creek watershed down through the Starnes Branch on the western side of this watershed and further south to the Callahan Branch. On the east side of the South Fork, clusters of Ceruleans were occupying the Little Salt Creek drainage and the western slopes of Fork Ridge.

It was impossible to be confident about identifying all individual territorial males in Houston South, particularly in cluster areas with high densities. The Cerulean Warbler defends a small territory, usually found to be 1 hectare or less (Buehler et al. 2020), and likely smaller in areas of higher density populations; pre-treatment surveys in the Hardwood Ecosystem Experiment detected many territory sizes in the 0.2 ha to 0.3 ha range in Yellowwood and Morgan-Monroe State Forests in 2007 and 2008 (Islam et al., 2013). When I located a singing male at Houston South, I would often be hearing others in a couple of directions at least. I would go and mark a nearby one, and then be listening and tracking again. As a one person tracking team, I couldn't confirm all territories in all directions, as birds move or stop singing. Therefore, I believe my numbers do not represent the maximum number of Cerulean territories, especially in high density cluster areas.

Covering such a large area (the entirety of Houston South Project area) meant that repeat visits to all territories were not possible. For the territories that we were able to revisit, there were occasional shifts in locations of individuals. For example, the males that were located on the western part of Fork Ridge Trail on April 28 were not present in the same location on June 1. Either the ones we observed on April 28 moved on as migrants, or they moved downslope towards the South Fork where we found seven new

male territories on June 1 that hadn't been observed on April 28. This change in location was the most obvious one we observed, but it also was the location with the greatest gap in time between visits. It is also the reason that our numbers indicate 82 separate male detections and not 82 separate confirmed territories. However, I can say with considerable confidence—based on behavior, date of detection, and percentage of birds remaining on territory on ensuing visits—that the great majority of these male Cerulean Warblers were defending territories.

Beyond the sheer abundance of Cerulean Warblers in Houston South, the most informative piece to come from this study might be the location of their territorial clusters. Very few males were observed more than a mile from the South Fork of Salt Creek, and most that were further away were located along a tributary flowing to the creek. Of particular interest for future Cerulean Warbler conservation and monitoring are the areas around Maumee: The junction of South Fork of Salt Creek and the Little Salt Creek, the slopes above Starnes Branch, the tributary of Fleetwood Branch near the junction of Trails 18 and 20, and the slopes of Fork Ridge into the South Fork bottomlands. A possible reason for the preference of these locations could be the presence of abundant understory cover in the floodplain habitat nearby that could offer excellent protection to fledglings.

As depicted in Appendix 2, the Cerulean males were found on slopes facing all directions and in a variety of forest types. The greater structure of the overall forest may be more predictive of the presence of Ceruleans. Many researchers have studied the Cerulean Warbler's preferred habitat, and "important habitat elements rangewide for this species appear to include large tracts of forest with big deciduous trees in mature to older-growth forest with horizontal heterogeneity of, or openings in, the canopy" (Buehler et al. 2020). This type of forest is provided currently in parts of the HNF and is evidenced in these cluster hotspots in Houston South.

In the Low Gap Nature Preserve and Backcountry Area straddling Morgan-Monroe and Yellowwood State Forests, we observed the same habitat preference and clustering in the IFA Ecoblitz project in 2016 and 2017 (Bishop et al., 2019). Those territories were clustered around Honey Creek and its tributaries at the southwest edge of the nature preserve. The Ceruleans seemed to prefer the floodplain and the surrounding slopes, similar to Houston South. Few if any Ceruleans were observed high on steep slopes or on ridgetops, and the nests we found at Honey Creek were close to floodplain forest.

In Houston South the nests, nest building, and nestlings that we documented provide a glimpse into the breeding behavior of the Cerulean Warblers that are present. Each of the three nesting sites was on the fork of a branch that was protected directly above by foliage (like an umbrella or shield) and mostly open to the understory below. Likely the openness below made it possible for us to find the nest in the first place; other females that we tracked unsuccessfully may have had more concealed nests.

In the successful nest that we monitored, I believe the young had fledged the nest along Trail 18 between my June 19 and June 29 visits. Cerulean Warbler young tend to fledge the nest within 10 or 11 days of hatching (Boves & Buehler, 2012), so they were unlikely to still be present in the nest when I visited on the 29th.

Any number of things may have happened to the nests that disappeared between visits. I witnessed the same thing happen during the nest building stage in the Low Gap Nature Preserve in 2017. Possible causes may have been high winds or storms, predation, or a simple change in location preference. We

witnessed a Cerulean female relocate her nest after a predation event in 2017 at Low Gap, so I believe it is likely that they move the nest by using the nest materials to rebuild it in another location.

In conclusion, the demonstrated presence of the imperiled Cerulean Warbler in Houston South should inform forest management planning and decisions. The greater Brown County Hills area—including state forest lands, Hoosier National Forest, Brown County State Park, and adjoining preserves and private lands—constitute the most important area for Cerulean Warbler reproduction in Indiana and the surrounding region. The density of Ceruleans here simply cannot be found elsewhere in the state.

Understanding the response of Cerulean Warbler populations and reproductive success to different forest management practices is essential in planning big impact management plans. A more subtle and nuanced approach may benefit the Cerulean in the long term (Boves et al., 2013). One possibility would be creating a 1.25-mile buffer from timbering and burning on each side of the South Fork of Salt Creek. The buffer would protect the dense Cerulean population clusters and the prime fledgling habitat. It would also provide the streams with protection from sedimentation and runoff. Clearly, Cerulean Warblers are thriving in the Houston South area and should remain a key part of this forest ecosystem.

References

Bishop, L. et al. 2019. Results of the Indiana Forest Alliance Ecoblitz at Morgan-Monroe / Yellowwood State Forest in Indiana. Proceedings of the Indiana Academy of Science 128(2):153–169.

Boves, T. J. and D. A. Buehler. 2012. Breeding biology, behavior, and ecology of Setophaga cerulea in the Cumberland Mountains, Tennessee. Southeastern Naturalist 11 (2):319-330.

Boves TJ, Buehler DA, Sheehan J, Wood PB, Rodewald AD, Larkin JL, et al. 2013. Emulating Natural Disturbances for Declining Late-Successional Species: A Case Study of the Consequences for Cerulean Warblers (Setophaga cerulea). PLoS ONE 8(1): e52107. https://doi.org/10.1371/journal.pone.0052107

Buehler, D. A., P. B. Hamel, and T. Boves. 2020. Cerulean Warbler (*Setophaga cerulea*), version 1.0. In Birds of the World (A. F. Poole, Editor). Cornell Lab of Ornithology, Ithaca, NY, USA. https://doi.org/10.2173/bow.cerwar.01

Hamel, P. B. 2000. Cerulean Warbler (Dendroica cerulea). In The Birds of North America, No. 511 (A. Poole and F. Gill, eds.). The Birds of North America, Inc., Philadelphia, PA.

Islam, K., K. J. Kaminski, M. M. MacNeil, and L. P. Young. 2013. The Cerulean Warbler in Morgan-Monroe and Yellowwood State Forests, Indiana: Pre-treatment Data on Abundance and Spatial Characteristics of Territories. Pages 61-77 in Swihart, Robert K.; Saunders, Michael R.; Kalb, Rebecca A.; Haulton, G. Scott; Michler, Charles H., eds. The Hardwood Ecosystem Experiment: a framework for studying responses to forest management. General Technical Report NRS-P-108. Newtown Square, PA: U.S. Department of Agriculture, Forest Service, Northern Research Station. 350 pp.

Pardieck, K.L., Ziolkowski Jr., D.J., Lutmerding, M., Aponte, V.I., and Hudson, M-A.R., 2020, North American Breeding Bird Survey Dataset 1966 - 2019: U.S. Geological Survey data release, https://doi.org/10.5066/P9J6QUF6.

Roth, K.L.; Islam, K. 2007. Do cerulean warblers (*Dendroica cerulea*) exhibit clustered territoriality? The American Midland Naturalist. 157(2): 345-355.

Photo 1. Black-and-white Warbler carrying food for nestlings along Polk Patch Rd.

Photo by Nancy Lightfoot, May 24, 2020

Photo 2. Red-eyed Vireo building nest (Trail 18).

Photo by David Rupp, May 30, 2020

Photo 3. Eastern Wood-Pewee finishing nest.

Photo by David Rupp, May 30, 2020

Photo 4. Worm-eating Warbler nest with chicks along Trail 20.

Photo by David Rupp, June 2, 2020

Photo 5. Female Cerulean Warbler.

Photo by Nancy Lightfoot, May 31, 2020

Photo 6. Female Cerulean Warbler collecting nesting material near trail 18.

Photo by Nancy Lightfoot, May 31, 2020

Photo 7. Cerulean Warbler nest (C21c) in white oak above Trail 21.

Photo by David Rupp, May 18, 2020.

Photo 8. Cerulean Warbler nest location in white oak by Trail 18.

Photo by David Rupp, May 30, 2020

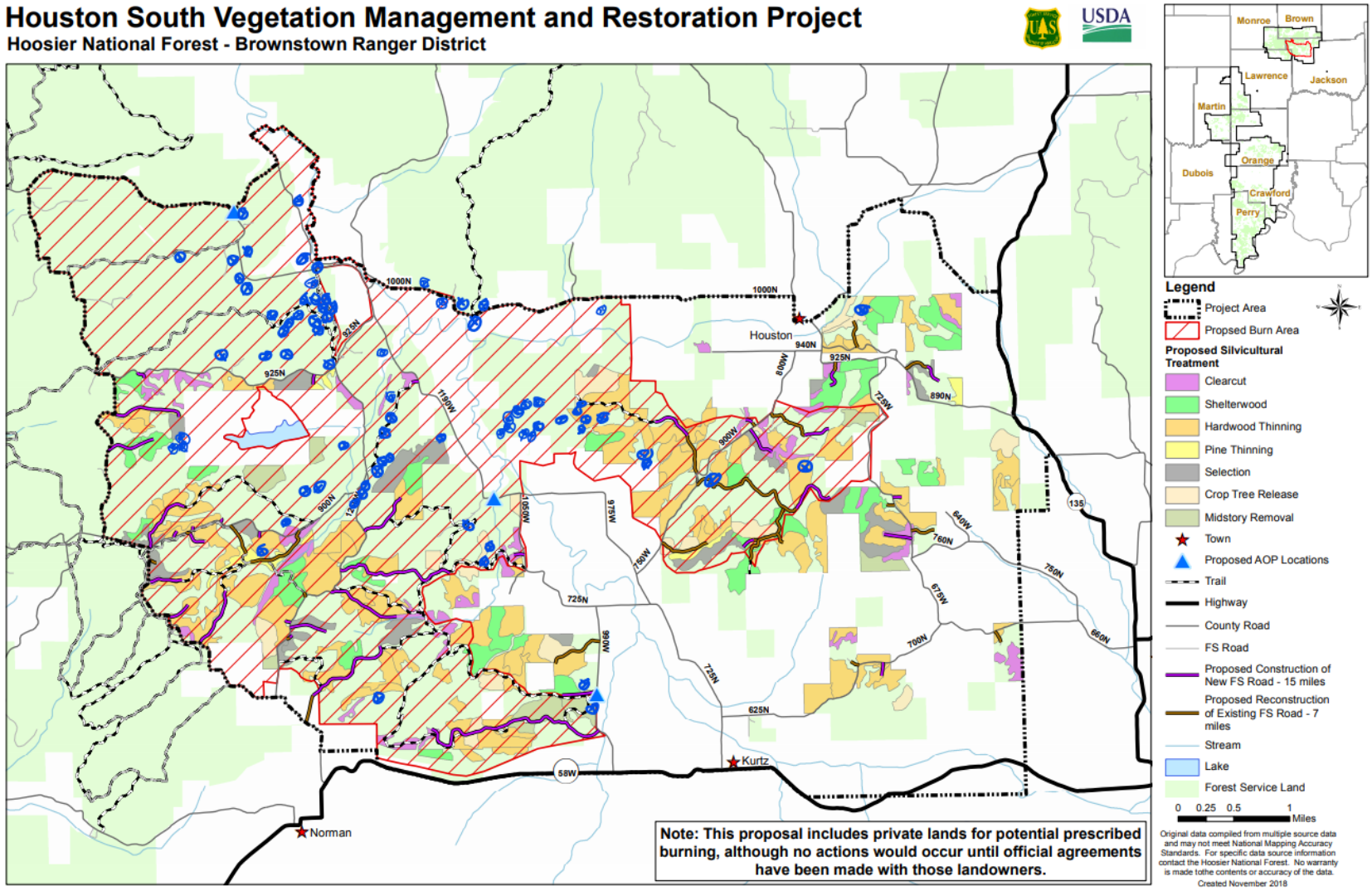
Photo 9. Nest nearing completion along Trail 18.

Photo by David Rupp, May 30, 2020

Photo 10. Cerulean female feeding young.

Photo by David Rupp, June 19, 2020.

Map 1. Overview of mapped locations of observed Cerulean Warbler males (blue circles) in Houston South Project area.



Map 2. Square mile area showing clustering of Cerulean Warbler males along Tower Ridge Rd and the Fleetwood Branch less than a mile from the South Fork of Salt Creek.